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EXAMINER	
THOMPSON, JAMES A	

ART UNIT	PAPER NUMBER
2624	

DATE MAILED: 04/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/512,378	Applicant(s) AU ET AL.	
	Examiner James A Thompson	Art Unit 2624	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 October 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9 and 11-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9 and 11-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 February 2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. *20050318*.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with James A. LaBarre (Reg #28,632) on 21 March 2005.

The application has been amended as follows:

a. On claim 13, line 9, change "coefficient; and" to "coefficient;".

b. On claim 22, line 4, change "an image processor for:" to "an image processor which performs the steps of:".

DETAILED ACTION

Response to Arguments

2. Applicant's arguments, see page 9, lines 7-13, filed 28 October 2004, with respect to the objection to claim 9 have been fully considered and are persuasive. The objection to claim 9 in item 1 of the Office action dated 05 May 2004 has been withdrawn.

3. Applicant's arguments, see page 9, line 14 to page 11, line 14, filed 28 October 2004, with respect to the rejections of claims 1-9 and 11-22 under 35 USC §112, first paragraph have been fully considered and are persuasive. Both the interview with Applicant's agent and the arguments presented on page 9, line 14 to page 11, line 14 of Applicant's arguments demonstrate that the specification fully provides enablement for the present claims. The rejections of claims 1-9 and 11-22 under 35 USC §112, first paragraph listed in item 2 of the Office action dated 05 May 2004 have been withdrawn.

4. Applicant's arguments, see page 11, line 15 to page 15, line 3, filed 28 October 2004, with respect to the rejections of claims 1-5 and 11-22 under 35 USC §102(b) and the rejections of claims 6-9 under 35 USC §103(a) have been fully considered and are persuasive. Therefore, the rejections have been withdrawn. However, upon further consideration, new grounds of rejection are made in view of the prior art specifically listed and discussed in the arguments below.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 2-4, 16 and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by Murakami (US Patent 5,268,771).

Regarding claims 2, 16 and 19: Murakami discloses defining a set of neighborhood pixels (figure 5 of Murakami) of the individual pixel (figure 5(A) and column 7, lines 34-37 of Murakami), the set of neighborhood pixels including the individual pixel and additionally a plurality of pixels (figure 5(B-F) of Murakami) proximate said individual pixel (column 7, lines 25-30 of Murakami); deriving for each pixel of the neighborhood (column 7, lines 39-42 and lines 48-51 of Murakami), a significance coefficient (figures 7A-7C and column 7, lines 54-61 of Murakami); and deriving the reconstructed value of the individual pixel (column 8, lines 35-41 of Murakami) as a sum over the pixel of the neighborhood of a product of the halftone image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel (column 8; lines 3-5, lines 19-22 and lines 31-34 of Murakami). Significance coefficients (figures 7A-7C and column 7, lines 54-61 of Murakami) are determined based on each neighborhood pixel's distance from the target pixel (column 7, lines 25-30 of Murakami) and the overall neighborhood gradient (column 7, lines 57-61 of Murakami).

Further regarding claim 16: The "first value" recited in claim 16 corresponds to the "halftone image value" recited in claim 2. Further, the "first image" recited in claim 16 corresponds to the "halftone image" recited in claim 2. Therefore, the limitations of claim 16 are fully embodied within the limitations recited in claim 2.

Further regarding claim 19: In order to process digital image data on a digital image data processor (figure 1(800) of Murakami), some form of computer program product which is readable by a computing device (figure 1(800) of Murakami) is inherent.

Regarding claim 3: Murakami discloses that said halftone image is derived from an original image having a continuous value for each pixel (column 8, lines 35-41 of Murakami), and, for each individual pixel (figure 5(A-F) and column 7, lines 31-37 of Murakami), said significance coefficient of each neighborhood pixel is an indication of the likelihood that the value of that neighborhood pixel in the original image is correlated with the value of the individual pixel in the original image (column 7, lines 54-61 and column 9, lines 33-39 of Murakami). The use of the term "restoration" (column 8, lines 35-41 of Murakami) implies that the image data was originally continuous value image data for each pixel. This is further evidenced by the fact that, in the background of Murakami, it is explained that restoring the original continuous value image data is the purpose of the method taught by Murakami (column 1, lines 16-21 of Murakami). The distance of the pixels from the target pixel (column 7, lines 31-37 of Murakami) combined with the gradient of the overall neighborhood (column 7, lines 54-61 of Murakami) provides a significance coefficient

for each neighborhood pixel. The higher the gradient of the neighborhood determines how fast the values of the neighborhood pixels change, and thus how different the surrounding pixels are from the target pixel. Said gradient, coupled with the distance from the target pixel of each individual pixel, provides a significance coefficient for each neighborhood pixel that is therefore a measure for each neighborhood pixel of the likelihood that the value of each neighborhood pixel is correlated with the value of the individual (target) pixel in the original image. Further, a greater number of coefficient matrices are possible in the system taught by Murakami, based on other varying conditions (column 9, lines 33-39 of Murakami).

Regarding claim 4: Murakami discloses that, for each individual pixel, said step of deriving a significance coefficient for each neighborhood pixel includes deriving a baseline value for the individual pixel, and deriving said significance coefficient as a function of the halftone value for the image at that neighborhood pixel and of the baseline value for the individual pixel (column 7, lines 55-61 of Murakami). The significance coefficient for each of the individual neighborhood pixels is a function of the gradient of the neighborhood of pixels (column 7, lines 55-61 of Murakami). This inherently requires a baseline value since the gradient is determined based on the absolute value of the difference in the image values over the area of the neighborhood. The baseline value is the value upon which these differences are based. The absolute value of the halftone value of the individual minus the baseline value determines the gradient of the image in the direction of said individual pixel.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 1, 5-8, 11-15, 17-18 and 20-22 rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami (US Patent 5,268,771) in view of Wong (US Patent 5,506,699).

Regarding claims 1, 18 and 22: Murakami discloses an apparatus (figure 1 of Murakami) comprising an image receiver (figure 1(100) of Murakami) for receiving said first image (column 5, lines 32-36 of Murakami); and an image processor (figure 1(500) of Murakami) which performs the steps of: for each pixel, defining a respective neighborhood (figure 5 of Murakami) containing that pixel (figure 5(A) and column 7, lines 34-37 of Murakami) and other pixels (figure 5(B-F) and column 7, lines 31-34 of Murakami); in a first iteration, obtaining for each individual pixel a continuous value (column 8, lines 35-41 of Murakami) by summing the products (column 8, lines 3-5 and lines 19-23 of Murakami) of weighting values (figures 7A-7C and column 7, lines 54-61 of Murakami) and binary values (CNT(A)-CNT(F)) of the pixels in the neighborhood of the individual pixel (column 7, lines 43-51 of Murakami), the weighting values being derived from the values of the first image (column 7, lines 56-61 of Murakami). The weighting values are the weighting values of the selected array (figures 7A-7C and column

7, lines 54-61 of Murakami). The array used is dependent upon the gradient of the pixels in the neighborhood of the target pixel (column 7,lines 56-61 of Murakami), and are thus derived from the binary values of the image before restoration. The binary values are determined for pixels A-F and used in summing the product of the binary values with the weights (column 8, lines 3-5 and lines 19-23 of Murakami).

Murakami does not disclose expressly performing, in further iterations, obtaining for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration.

Wong discloses converting a halftone image into a continuous tone image (figure 3("Binary Image","Gray Scale Image") and column 5, lines 4-7 of Wong) by performing multiple iterations upon the obtained restoration data (figure 3(22,24) and column 5, lines 6-12 of Wong).

Murakami and Wong are combinable because they are from the same field of endeavor, namely the conversion of halftone data into restored grayscale data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform multiple iterations of the restoration method, as taught by Wong, said restoration method being the restoration method taught by Murakami. Therefore, in further iterations, the method taught by Murakami would obtain for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous

iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration. The binary values (CNT(A)-CNT(F)) can easily be modified by one of ordinary skill in the art to count the number of "1" binary values in the previous iteration of grayscale values since the "1" binary value represents a white halftone dot used in the representation of a grayscale value. The principle is the same as taught in Murakami (column 7, lines 43-49 of Murakami), so the modification is minor and well within the ability of one of ordinary skill in the art. As is well-known in the art, a method such as taught by Murakami will inherently have some level of error with respect to the original image that is to be restored. Iteratively performing such a method allows for a convergence of solution, thereby obtaining a result with less overall error. Therefore, the suggestion for performing the method of Murakami in the iterative manner taught by Wong, would be to obtain a convergence of a solution, thereby minimizing the resultant error in the restored grayscale image. Therefore, it would have been obvious to combine Wong with Murakami to obtain the invention as specified in claims 1, 18 and 22.

Further regarding claims 1 and 18: The image processor of the apparatus of claim 22 performs the method of claim 1. The computer program product of claim 18 is embodied in the image processor of the apparatus of claim 22.

Regarding claim 5: Murakami does not disclose expressly that the baseline value for the individual pixel is derived by low pass filtering of the halftone image.

Wong discloses deriving a baseline value for the individual pixels by low pass filtering the halftone image (figure 2(18) and column 5, lines 6-9 and lines 13-17 of Wong).

Murakami and Wong are combinable because they are from the same field of endeavor, namely the conversion of halftone data into restored grayscale data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a low pass filter to obtain the baseline value, as taught by Wong. The motivation for doing so would have been to avoid overly blurring the resultant image (column 5, lines 16-19 of Wong). Therefore, it would have been obvious to combine Wong with Murakami to obtain the invention as specified in claim 5.

Regarding claim 6: Murakami discloses that, for each individual pixel, the significance coefficient for each neighborhood pixel is a decreasing function $f(v)$ of the absolute difference (v) between the halftone value at that neighborhood pixel and the baseline value for the individual pixel (figures 7A-7C and column 7, lines 55-61 of Murakami).

As disused above in the arguments regarding claim 4, the gradient is determined based on the absolute value of the difference in the image values over the area of the neighborhood. The baseline value is the value upon which these differences are based. The absolute value of the halftone value of the individual minus the baseline value determines the gradient of the image in the direction of said individual pixel. The significance coefficient for a particular pixel decreases as the gradient, or absolute difference, increases, as demonstrated in figures 7A-7C of Murakami. Figure 7A of Murakami is an example of when the gradient is most abrupt (column 7, lines 58-60 of Murakami).. The farthest pixel will therefore have the

largest absolute differences in halftone values between themselves and the target pixel. However, the farthest pixels also have the lowest significance coefficient values (figure 7A("1") of Murakami). In the cases of lessening gradients, and thus lower absolute differences (column 7, lines 58-61 of Murakami), the same pixels have higher significance coefficients (figure 7B("2" in same positions as "1" in figure 7A) and figure 7C("4" in same positions as "1" in figure 7A) of Murakami). Therefore, $f(v)$ is a decreasing function of the absolute difference (v) between the halftone value at that neighborhood pixel and the baseline value for the individual pixel.

Regarding claims 7 and 8: As discussed above in the arguments regarding claims 5 and 6, Murakami in view of Wong teaches that the significance coefficient is a function $f(v)$ which is a decreasing function of the absolute difference (v) between the halftone value at a neighborhood pixel and the baseline value for the individual pixel, wherein said baseline value for said individual pixel is derived by low pass filtering of the halftone image. Therefore, given a low-pass filtered value for the baseline value and the relationship of a low-pass filtered value with the value itself, $f(v)$ is both a non-linear and a continuous function.

Regarding claim 11: Murakami does not disclose expressly forming an enhanced reconstructed image as a linear combination of said reconstructed image and a continuous image derived from said halftone image by a second image reconstruction method.

Wong discloses forming an enhanced reconstructed image as a linear combination of said reconstructed image (figure 3(24) of Wong) and a continuous image derived from said halftone image by

a second image reconstruction method (figure 3(26) of Wong) (column 6, lines 35-37 of Wong).

Murakami and Wong are combinable because they are from the same field of endeavor, namely the conversion of halftone data into restored grayscale data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a final low pass filter in linear combination with the reconstructed image, as taught by Wong. The motivation for doing so would have been to remove unwanted high frequency components that may be generated at the final stage of continuous-tone image reconstruction (column 6, lines 35-37 of Wong). Therefore, it would have been obvious to combine Wong with Murakami to obtain the invention as specified in claim 11.

Further regarding claim 12: Wong discloses that said second image reconstruction method is a low pass filter (figure 3(26) and column 6, lines 35-37 of Wong).

Regarding claims 13 and 20: Murakami discloses defining a set of neighborhood pixels (figure 5 of Murakami) of the individual pixel (figure 5(A) and column 7, lines 34-37 of Murakami), the set of neighborhood pixels including the individual pixel and additionally a plurality of pixels (figure 5(B-F) of Murakami) proximate said individual pixel (column 7, lines 25-30 of Murakami); deriving for each pixel of the neighborhood (column 7, lines 39-42 and lines 48-51 of Murakami), a significance coefficient (figures 7A-7C and column 7, lines 54-61 of Murakami); and deriving a first reconstructed value of the individual pixel (column 8, lines 35-41 of Murakami) as a sum over neighborhood pixels of a product of the halftone image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel (column 8;

lines 3-5, lines 19-22 and lines 31-34 of Murakami). Significance coefficients (figures 7A-7C and column 7, lines 54-61 of Murakami) are determined based on each neighborhood pixel's distance from the target pixel (column 7, lines 25-30 of Murakami) and the overall neighborhood gradient (column 7, lines 57-61 of Murakami).

Murakami does not disclose expressly M further steps, $m = 1,\ldots,M$ $(M \geq 1)$, of, for successive individual ones of said pixel, rederiving a significance coefficient for each neighborhood pixel; and deriving an $(m+1)$-th reconstructed value of the individual pixel as a sum over the neighborhood pixels of the product of the m-th reconstructed value at that neighborhood pixel with the significance coefficient of that neighborhood pixel.

Wong discloses converting a halftone image into a continuous tone image (figure 3("Binary Image","Gray Scale Image") and column 5, lines 4-7 of Wong) by performing multiple iterations upon the obtained restoration data (figure 3(22,24) and column 5, lines 6-12 of Wong).

Murakami and Wong are combinable because they are from the same field of endeavor, namely the conversion of halftone data into restored grayscale data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform multiple iterations of the restoration method, as taught by Wong, said restoration method being the restoration method taught by Murakami. Therefore, the system of Murakami, in view of the teachings of Wong, would execute M further steps, $m = 1,\ldots,M$ $(M \geq 1)$, of, for successive individual ones of said pixel, rederiving a significance coefficient for each

neighborhood pixel; and deriving an $(m+1)$-th reconstructed value of the individual pixel as a sum over the neighborhood pixels of the product of the m-th reconstructed value at that neighborhood pixel with the significance coefficient of that neighborhood pixel. As is well-known in the art, a method such as taught by Murakami will inherently have some level of error with respect to the original image that is to be restored. Iteratively performing such a method allows for a convergence of solution, thereby obtaining a result with less overall error. Therefore, the suggestion for performing the method of Murakami in the iterative manner taught by Wong, would be to obtain a convergence of a solution, thereby minimizing the resultant error in the restored grayscale image. Therefore, it would have been obvious to combine Wong with Murakami to obtain the invention as specified in claims 13 and 20.

Further regarding claim 20: In order to process digital image data on a digital image data processor (figure 1(800) of Murakami), some form of computer program product which is readable by a computing device (figure 1(800) of Murakami) is inherent.

Regarding claims 14, 17 and 21: Murakami discloses the method of claim 2, the arguments of which are incorporated herein.

Murakami does not disclose expressly preprocessing the halftone image by a filtering algorithm to derive a preprocessed image having a preprocessed image value for each of said pixels.

Wong discloses preprocessing the halftone image by a filtering algorithm (figure 2(18) of Wong) to derive a preprocessed image having a preprocessed image value for each of said pixels (column 5, lines 6-8 of Wong). The first stage by

which the initial binary data is processed in a low-pass filter (figure 2(18) and column 5, lines 7-8 of Wong).

Murakami and Wong are combinable because they are from the same field of endeavor, namely the conversion of halftone data into restored grayscale data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preprocess the halftone image, as taught by Wong, before performing the method taught by Murakami. The motivation for doing so would have been to remove unwanted high frequency components (column 5, lines 13-16 of Wong) from the halftone binary image. Therefore, it would have been obvious to combine Wong with Murakami to obtain the invention as specified in claims 14, 17 and 21.

Further regarding claim 17: The "first value" recited in claim 17 corresponds to the "halftone image value" recited in claim 14. Further, the "first image" recited in claim 17 corresponds to the "halftone image" recited in claim 14. Therefore, the limitations of claim 17 are fully embodied within the limitations recited in claim 14.

Further regarding claim 21: In order to process digital image data on a digital image data processor (figure 1(800) of Murakami), some form of computer program product which is readable by a computing device (figure 1(800) of Murakami) is inherent.

Regarding claim 15: Murakami discloses that, for each individual pixel, said step of deriving a significance coefficient for each neighborhood pixel includes deriving a baseline value for the individual pixel, and deriving said significance coefficient as a function of the preprocessed value for the image at that neighborhood pixel and of the baseline

value for the individual pixel (column 7, lines 55-61 of Murakami). The significance coefficient for each of the individual neighborhood pixels is a function of the gradient of the neighborhood of pixels (column 7, lines 55-61 of Murakami). This inherently requires a baseline value since the gradient is determined based on the absolute value of the difference in the image values over the area of the neighborhood. The baseline value is the value upon which these differences are based. The absolute value of the preprocessed value of the individual minus the baseline value determines the gradient of the image in the direction of said individual pixel.

9. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami (US Patent 5,268,771) in view of Wong (US Patent 5,506,699) and obvious engineering design choice.

Regarding claim 9: Murakami in view of Wong does not disclose expressly that $f(v)$ is a function of the form $f(v)=a(1-v/b)^k$. However, Murakami does disclose that a plurality of coefficient matrices can be stored and selected from based according to various conditions (column 9, lines 33-39 of Murakami). Therefore, specifically selecting the equation $f(v)=a(1-v/b)^k$ to design the coefficient matrices to use in the system taught by Murakami in view of Wong is an obvious engineering design choice. At a certain level, a specific formula for designing the matrices must be selected in order for there to be a practical construction of the system taught by Murakami in view of Wong. One of ordinary skill in the art at the time of the invention would be motivated to specifically use

the equation $f(v)=a(1-v/b)^k$ for very specific image restoration conditions and/or problems.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

James A. Thompson
Examiner
Art Unit 2624

JAT
08 April 2005

THOMAS D. LEE
PRIMARY EXAMINER